Comparison of Minnesota PFOA and PFOS Non-Cancer Health Based Drinking Water Values (nHBVs) with EPA and States with their Own Standards

The DES Environmental Health Program has reviewed the technical documents provided by the State of Minnesota describing the basis for the development of their nHBVs for PFOA and PFOS.

PFOA Drinking Water Standards Comparison

Parameter	EPA	VT	NJ	MN
Critical Effect	Delayed ossification, other developmental endpoints (Lau, 2006)	Delayed ossification, other developmental endpoints. Same study as EPA.	Increased liver weight (Loveless et al, 2006)	Delayed ossification, other developmental endpoints. Same study as EPA.
Exposed Receptor Used to Derive Standard	Lactating woman	Infant, breast- or formula fed	Adult	Infant, breastfed (breastfed was more sensitive than formula fed)
Total Uncertainty Factors (UFs) (1)	300	300	300	300
[redacted] (RfD) (mg/kg/day)	[redacted]	[redacted]	[redacted]	[redacted]
Relative Source Contribution from water (RSC)	20%	20%	20%	50%
Value (ng/L)	70	20	14	35

(1) Although the total UFs are equal for deriving each RfD, the choice of which UFs were assigned a numerical value of greater than 1 (either 3 or 10) are not the same for EPA, NJ, and MN. VT used EPA's RfD, so the EPA and VT UFs are identical.

PFOS Drinking Water Standards Comparison

Parameter	EPA	MN
Critical Effect	Decreased pup body weight (Luebker, 2005)	Decreased pup body weight Same study as EPA
Exposed Receptor Used to Derive Standard	Lactating woman	Infant, breast fed (was more sensitive than formula fed)
Total Uncertainty Factors	30	100 (1)
Reference Dose (RfD) (mg/kg/day)	2E-5	5.1E-6
Relative Source Contribution from water (RSC)	20%	50%
Value (ng/L)	70	27

(1) MN used an additional UF of 3 for database uncertainty because of the need for additional studies investigating immunotoxic effects

PFOA

Minnesota used the same mouse developmental study (Lau, 2006) and total uncertainty factor value (300) as EPA to derive a similar Reference Dose (RfD) of 1.8 E-5 mg/kg/day. EPA rounded their RfD to 2E-5 mg/kg/day. MN used a relative source contribution from water of 50% based on NHANES PFOA serum results in the general population, assumed to be representative of background exposure from non-water sources.

MN used a toxicokinetic model based on several parameters including PFOA half-life, clearance rate of PFOA from the body, a placental transfer factor, a breast milk transfer factor, and upper percentile water and breast milk ingestion rates to determine a PFOA water concentration that would keep the PFOA serum levels in an infant and over the years as the infant becomes a child/adult to no higher than 50% of the serum level corresponding to their RfD.

Potential receptors examined were exclusively formula fed infants for one year followed by these infants ingesting contaminated water through adulthood and exclusively breast fed infants for one year followed by these infants ingesting contaminated water through adulthood. Model results indicated that breast fed infants were a more exposed receptor than formula fed by a factor of approximately 4-fold.

PFOS

MN used the same study as EPA for the critical health effect (Luebker, 2005). However, MN used a total UF of 100 instead of the 30 UF used by EPA for deriving its RfD. Also, Instead of using the NHANES PFOS serum background value to choose an appropriate RSC as they did for PFOA, MN used a State based (identified as "new East Metro residents") 95th percentile background serum PFOS value of 21 µg/L . The 95th percentile serum PFOS value from the 2011-2012 NHANES sampling is 21.7 µg/L. Otherwise, MN used the same methodology for deriving the PFOS drinking water standard as they did for PFOA. Model results indicated that breast fed infants were a more exposed receptor than formula fed by a factor of approximately 2-fold.

General - PFOA and PFOS

For both PFOA and PFOS, MN evaluated a formula fed and a breast fed infant. The breast fed infant was by far the more sensitive population. The PFOA and PFOS levels in water that would result in blood serum levels below a health concern for a formula fed infant were 150 ng/L for PFOA and 60 ng/L for PFOS. These values can be compared to the drinking water standards derived to protect the breast fed infant of 35 and 27 ng/L for PFOA and PFOS, respectively.

To develop their drinking water standards, MN derived population based blood serum values for PFOA and PFOS corresponding to their RfDs. Although MN notes that these serum values are not appropriate for clinical assessment or interpreting individual serum values, they are 130 and 63 µg/L for PFOA and P[redacted]

MN used RSCs of 50% for both PFAS in deriving their standards based on the NHANES 95th percentile PFOA serum background concentration and a MN specific 95th percentile PFOS background serum concentration, which is similar to NHANES 95th percentile PFOS background concentrations. These background concentrations are only 4% and 33%, respectively, of the serum concentrations corresponding to the no adverse effect levels for total exposure represented by the MN RfDs. Therefore, MN RSCs of 50% are very protective when compared to the actual percentages of the PFOA and PFOS background concentrations.

Validity testing of the MN model was conducted using PFAS blood serum data from several different studies of mothers and infants, the majority of the infants who were exclusively breast fed. The MN model was also compared with another draft model developed to estimate PFAS serum concentrations in nursing infants up to three years of age. In general, the MN model was accurate within a factor of two. Additionally, six external peer reviewers were asked to review the model and provide comments on ways to improve the accuracy of the model. The reviewers are toxicologists/risk assessors with expertise in pharmacokinetic and mathematical modeling, including modeling of chemicals (solvents, PCBs, PFOA, PFOS, PFHxS) in human milk, children's exposure to environmental chemicals, and PFAS subject matter.